"SMALLPOX THEN AND NOW"

by

"Stephanie McDonald "

"April 7, 2003"

**A Master's paper submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Master of Public Health in the School of Public Health, Public Health Leadership Program.**

Approved by:

Jane Murray

Content Reader: Jane Murray, MS
Health Director

William Williamson

Second Reader: William Williamson, MPH

Smallpox has claimed millions of lives during its existence. Deaths from the disease far out numbered that of the bubonic plague, the Black Death of the Middle Ages, and the wars of the 20th century all combined. Survivors of the disease acquired immunity but suffered a variety of long-term afflictions, such as permanent scarring, disfiguration, and blindness (Tucker, 2001). Although smallpox was eventually eradicated from the wild, it left a long trail of sickness and deaths that afflicted people of every race, class and social status. Even as recently as 1967, the disease continued to leave a devastating impact on the world causing an estimated two million deaths (Tucker, 2001). After the declaration of freedom from smallpox occurred in 1980, the terror of the disease faded from our awareness (Tucker, 2001). While some would consider smallpox to be a disease of the past and long forgotten, such consideration would be premature.

The origin of smallpox still remains unclear. It is believed that the disease may have been contacted through livestock ten thousand years ago (Clark, 1995). The only vector and reservoir for the disease is human and other animals such as cows and monkeys carry similar diseases known as cowpox and monkey pox. Smallpox is spread through water droplets containing the virus, which an infected person exhales into the air and a new victim then inhales. Although some populations appeared to have had an immunity, the disease often killed as many as half of those it infected and left the skin of survivors pitted with pockmarks, thus giving the virus its name. The virus then multiplies in the host and spreads through the lymph system for about two weeks. The incubation period averages 10-12 days, with a range of 7-17 days (Paustian, 2000).

The first symptoms of smallpox were usually characteristic of the flu and made it hard to distinguish the two diseases. Victims suffered from headaches, muscle aches and a high fever. After a couple of days, the first signs of the rash began to appear on the face and mouth of the

victim. The lesions spread from the face to the eyes and eventually to the entire body where they formed pustules. The pustules then scabbed over causing scarring (Paustian, 2000).

The first suspected case of smallpox was believed to be that of Pharaoh Ramses V of Egypt. Findings suggest that his sudden death, mummified face, neck and shoulders indicated the possibility of smallpox (Clark, 1995 & Paustian, 2000). Over the course of history, smallpox has been a recurring enemy that spread to every corner of the earth. It occurred, even in ancient times and those who were afflicted and survived, were granted immunity. They could not get smallpox again (Paustian, 2000). Although smallpox was thought to exist in China and India, the first written recording of the disease did not appear until the $10^{th}$ century in a work by Rhazes, a Persian physician who resided in Baghdad (Clark, 1995; Winslow, 1974).

Smallpox grew rapidly affecting towns and cities in ancient Egypt and Mesopotamia. Large populations of people provided ample opportunity for the virus to spread. Births and new adult settlers enabled smallpox to be transmitted continually to a pool of susceptible individuals enabling to the disease to be transmitted repeatedly without ever running out of hosts. The demographic threshold at which the population could sustain the disease was around 200,000 people (Tucker, 2001).

Two factors that influenced the toll that smallpox inflicted on human populations were epidemiological and genetic. A person of foreign descent who introduced the virus into an isolated community could spread the virus explosively, giving rise to a devastating epidemic that killed people of all ages. As victims died or became immune, the disease diminished. The longer a society lived with smallpox, the less severe its demographic impact became. In heavily populated areas, the disease smoldered continuously at low levels and the intervals between the major outbreaks were fairly short. As a result, the majority of victims were children. In rural

areas where the population was too small to support continuous transmission, smallpox was introduced periodically from outside. Since people living in such areas were less likely to encounter the disease in childhood, periodic epidemics affected adolescents, young adults and infants (Tucker, 2001).

Although smallpox was spread from person to person, it could only exist in areas where susceptible people were available to keep the disease going. Smallpox especially caused large epidemics in virgin communities because everyone was susceptible to the disease. After most of the susceptible people had been infected and became immune or died, the disease died down.

Reintroduction of the disease often occurred after enough new or susceptible people had been born or moved into the area. This caused frequent reappearances that affected mostly young children because adults and older citizens already had the disease months or years before. In some larger communities, the virus never disappeared entirely but was constantly present (endemic), going form one susceptible person to another and erupting into epidemics every five to fifteen years (Hopkins, 1983).

The second factor that affected the mortality caused by smallpox was the evolution of genetic resistance. People varied in their susceptibility to infectious diseases, and resistant individuals were more likely to survive epidemics. When smallpox first appeared in the old world, it apparently caused very high death rates. As the susceptible individuals were moved from the population, more resistant survivors came to dominate the gene pool and the impact of the disease gradually became less devastating (Tucker, 2001).

Smallpox was a disease that had no distinction. It killed royalty as well as commoners, disrupting dynasties and alliances and repeatedly changing the course of world history. It killed more people than any other infectious disease (Tucker, 2001). Once a person became ill with the

virus, he/she shed millions of infective viruses into the immediate environment from the rash on the skin and open sores in the throat. Each victim remained infectious until the last scab dropped off of the body. However, this was the time when the virus was highly contagious. Contaminated clothing and blankets served as vehicles for the virus and those who were not in direct contact with a patient could become infected as a result of contact with these items. Most victims became infected through droplet infection while engaging in face-to-face contact with a patient by inhaling contaminated air. Very rarely was airborne smallpox virus known to have infected another beyond the immediate vicinity of the victim (Hopkins, 1983).

During the first week after infection, the virus quietly established itself in an infected person. This stage, known as prodromal was marked by initial signs and symptoms, which included headache, fever, chills, nausea, backache, convulsions and delirium. Some victims experienced terrifying dreams, which lasted up to four days. Fair skinned individuals developed coloration on their faces that extended over their entire bodies. At the end of prodrome, the fever left and the person temporarily felt better. At that point, the virus declared its presence by producing the characteristic rash. Typically, the flat reddish spots appeared first on the face, and then spread rapidly over the arms, chest, back, and legs. The rash was denser on the face, lower arms and legs than on the center of the body. Over the next several days, the "miserable aching" victim evolved into a "hideous, swollen monster" as the flat spots of the rash became raised pimples, then blisters and then pustules after which the pustules dried up and turned into crusts or scabs. Some patients appeared exactly as if they had been severely scalded, burned and felt as if their skin was on fire. The virus not only attacked the skin, which in some cases sloughed off in huge pieces, but also attacked internal organs which is how death usually occurred. Many died in the first few days of the rash; others soon after the first week of the rash and some were

carried to their graves even before the rash appeared. Once a person was infected, there was no effective treatment (Hopkins, 1983).

In fulminating infections, death usually occurred within three to five days, often caused by overwhelming toxemia or massive hemorrhaging into the skin, throat, lung, intestine or uterus. Such patients had no characteristic papular or vesicular eruption, only a nonspecific red or violet patchy, petechial, or morbilliform rash such as may be seen in many other severe infections where natural clotting mechanisms are thrown into chaos (Hopkins, 1983; Wilson 1994). In other malignant infections, the smallpox virus caused diffuse destruction in the dermis, or deeper layer of the skin, and the patient died between ten and fourteen days after onset of symptoms of the initial phase. Smallpox deaths attributable to complications other than hemorrhage usually occurred 18 days or more after symptoms began. These other potentially life-threatening complications most often resulted from secondary bacterial infections of wounds in the skin originally caused by the virus. The virus itself was usually responsible for destroying sebaceous glands, which resulted in the characteristic permanent pockmark's being most common on the most visible part of the body. A few patients developed drowsiness and speech disorders in the second week of illness. In about 1% of patients the virus caused ulcerations of the cornea, usually starting around the fourteenth day of illness, and resulted in permanent blindness of the affected eye. Blindness and secondary septic infections were apparently more frequent in undernourished victims. Recently, evidence has also emerged that scars resulting from smallpox lesions in the epididymis may have been a significant cause of infertility in male survivors. The disease's most characteristic features, namely, the tendency of the rash to be denser on the face, hands and feet remains unexplained (Hopkins, 1983).

In England, the "speckled monster" as it was called appeared suddenly and included high fever, chills, nausea, and vomiting. After 2 to 4 days, the fever disappeared and a rash appeared on the face and inside the eyes and covered the entire body. These skin lesions evolved into vesicles and pustules; and finally dried into scabs that fell off after 3 to 4 weeks. This sequence of events was characteristic of variola major (Hopkins, 1983).

In Boston, there were 1596 reported cases and 270 deaths in the city between 1901 and 1903 (Albert, Ostheimer, Liewehr, Steinberg & Breman, 2002). All patients with smallpox during the epidemic were held at the Southampton Street or Gallop's Island hospitals . The hospitals served as the major smallpox isolation and quarantine facilities. Smallpox patients were strictly excluded from other hospitals in the city. This is an early example of measures taken to quarantine and isolate smallpox patients.

Smallpox was a ruthless, virulent killer whose epidemics once swept through Europe, the Americas, Asia and Africa, wiping out uncounted millions. The disease killed 200,000 to 600,000 Europeans yearly throughout most of the eighteenth century (Kiernan, 1997). In London smallpox was observed as being hardest on the sick or undernourished and people would often deliberately expose their children to it based on the assumption that it was better to deal with it while one was young and healthy. As a result, among poor people in particular where this was practiced, smallpox was mostly a disease of the young. Children who survived exposure were protected to a considerable extent as adults. Those who did not survive were perceived as being one less mouth to feed. This process of deliberate exposure of the young was the nearest that people in the West came to a program for not only gaining some control over smallpox, but to preventing it (Clark, 1995).

It was common knowledge that survivors of smallpox became immune to the disease. As a result, physicians and others intentionally infected healthy people with the smallpox organism in the hope that the resulting infection would be less severe than the naturally occurring illness and would create immunity (Nicolau, 1997). Children were exposed to organisms from persons with mild cases of smallpox, and various forms of material from persons with smallpox were administered to healthy adults in different ways. This method of immunization was named variolation and involved taking samples of scabs or pus from patients in whom the disease had been benign and introducing this material into other persons through the nose or skin (Nicolau, 1997; Paustian, 2000). The practice of variolation was first reported as early as the tenth century in China. It was widely practiced in the Ottoman Empire in the 1600's where smallpox materials were variolated into the skin (Paustian, 2000). The practice was introduced to women who were in great demand because of their legendary beauty. As children, they were inoculated in parts of the body where scars would not be seen (Nicolau, 1997).

One of the more colorful figures involved in bringing the practice of variolation to the West was Lady Mary Wortley Montague. Born into an aristocratic family in 1689, she eloped with Edward Wortley Montague. Shortly into the marriage, Lady Mary was strickened with smallpox. Although she recovered rapidly from the disease, her beauty was ever after blemished by pocked skin and loss of her eyelashes. Several months after her recovery, she and her husband went to Constantinople where Lady Mary became interested in the Turkish practice of inoculation. Impressed by what she saw, she allowed her own son to be treated by the method. The embassy chaplain criticized the practice as "un-Christian" and would have nothing to do with it. The boy developed what appeared to be a slightly stronger than usual reaction, with high

fever and numerous pustules. However, the treatment was a complete success and the young Montague enjoyed many years of protection against smallpox (Clark, 1995; Hopkins, 1983).

Several years after returning to London, another epidemic occurred and the Montague's had their daughter treated by the same method. The treatment was again successful. Although inoculation was embraced by the upper class at the time, it never really caught on with the general population. Since the procedure was not completely safe, some were concerned about the risks and were not convinced that protection was genuine or long lasting. Some felt that the method had the potential to actually spread the disease, while others opposed it for religious reasons. Clergy believed that God found pleasure in imparting smallpox disease to individuals and believed that it was a test of the individual's faith (Clark, 1995). They also believed that human beings had no business meddling around with and possibly opposing divine providence. There were clearly genuine reasons for concern, which although not obviously always directly attributed to inoculation, caused a great deal of apprehension at the time (Clark 1995; Hopkins, 1983).

Variolation in the United States began along an independent path. Reverend Cotton Mather of Boston heard about the variolation practice in Africa. After acquiring additional information, Mather began seeking physicians in Boston who would perform the practice as a defense against the attacks of smallpox that frequently cycled through the community. He as well as other physicians during that time performed successful variolations, which led to fewer smallpox deaths. Eventually the practice gradually discontinued (Oldstone 1998; Winslow, 1974).

Smallpox afflicted humankind as no other disease had done. The disease brought down at least three empires. Generations watched helplessly as children succumbed to the disease,

were disfigured or blinded by the disease. Attempts were made to contain smallpox by isolating the sufferers and by using variolation (Nicolau & Domingo, 1997).

Until just a few centuries ago, smallpox was still a mystery. Neither the nature of the organism causing smallpox nor the fact that it had a specific cause was comprehended. The transmission of the disease and its existence was not fully understood. This lack of knowledge was slowly withdrawn as conflicting beliefs, observations, and false interpretations overlapped and masked early opportunities to verify theories that are now known to be true. Before the Christian era, ancient civilizations believed that pestilences such as smallpox were punishments released on mankind by divine judgment as payback for wicked behavior. Even among early Christians, this view was expanded to include the belief that God would also use disease to purge and cleanse man of his sins. Others attributed sudden epidemics such as smallpox to changes in the atmosphere. Each of the theories about the nature of the smallpox formed the basis for countermeasures undertaken in good faith to prevent or treat the disease by those who believed (or whose doctors believed) in them (Winslow, 1974).

These beliefs were still evident in some countries as recently as the 1960s and 1970s. For theurgists, smallpox was thought to be prevented by appeasing the deity who controlled the disease and by avoiding acts that earned his or her wrath. To Christians, this meant avoiding sin. Humoralists sought to restore the imbalance smallpox signified by bleeding or purging the body of excessive humors. Rhazes "heat therapy" as well as "red treatment" were rationalized on the basis of his belief in the innate. For eighteenth century Europeans who believed that the disease was triggered by luxurious living and an injudicious diet, the diet of smallpox patients, including those who took the infection by inoculation, were restricted to minimize the severity of the infection (Winslow, 1974).

In some cultures, the impact of smallpox was reflected in the widespread practice of worshipping gods, goddesses and patron saints. The disease was thought to be a spirit possession illness caused by family spirits. The afflicted person underwent public dancing and the community, consisting of neighbors and family members gathered around and sang songs.Dancing was done at the request of the possessed. The participation of the community gave spirit possession a public character. In Japan a picture of Tametomo, a 12th century hero who killed a smallpox demon, hung in rooms of smallpox victims to aid their recovery. (Winslow, 1974). In West Africa, the Yoruba and neighboring tribes worshipped a smallpox deity. Superstitious practices to ward off smallpox were also widespread. People tried to protect themselves from infection by holding vinegar-soaked rags over their noses, wearing charms of animal teeth or bags of camphor around their necks and carrying pieces of tarred rope. Also in West Africa, the Yoruba and neighboring tribes worshipped a smallpox deity. Superstitious practices to ward off smallpox were also widespread. People tried to protect themselves from infection by holding vinegar-soaked rags over their noses, wearing amulets of animal teeth or bags of camphor around their necks and carrying lengths of tarred rope (Buckley, 1985).

Historically, when epidemics such as smallpox occurred, authorities prohibited people from engaging in certain everyday activities, such as conjugal relationships and house-to-house visitations. These prohibitions were practical as well as symbolic since nuclear and extended family contacts were important in nonindustrial societies. The suspension of normal activities reminded the community that it was in a dangerous state. Wastes were disposed of, houses were burned down following deaths from illnesses such as smallpox and villages were periodically relocated in order to free them of vermin (Feierman & Janzen, 1992).

A major obstacle to the effective prevention of smallpox was that many of the technical problems with vaccination remained unsolved. In addition to the difficulty of keeping cowpox alive, it was hard to distinguish it from other viruses. A key breakthrough in the control of smallpox in industrialized countries was the invention of the icebox, which made it possible to refrigerate smallpox vaccine and thereby preserve its potency for longer periods (Tucker, 2001).

The smallpox virus also greatly affected various armies. In the fourth century BC, the disease ravaged Alexander the Great's army during a campaign in India. The Roman Emperor Marcus Aurelius died of smallpox in A.D. 180, accelerating a decline of the Roman Empire. During the Elephant war in A.D. 570, Abyssinian troops on elephants besieging the Arab capital of Mecca were destroyed by an outbreak of smallpox (Tucker, 2001). In the seventh and eighth centuries, Arab armies carried smallpox across North Africa and into the Iberian Peninsula. From the $11^{th}$ –$13^{th}$ centuries, crusaders returning to Europe form the Holy Land and traders plying the Silk Road to China dispersed the disease widely. In Great Britain in the late $15^{th}$ century, the pustular skin rash came to be called the "small pockes" (from pocke, meaning sac) to distinguish it from syphilis, then known as the "great pockes"(Tucker, 2001).

Disease has long been a major mortality factor in war, frequently changing the course of a battle or entire campaign. Prior to WWII, military losses from diseases were always greater than losses from battle wounds. At the time of the American war for independence, smallpox was a fearsome disease indeed, striking old and young, rich and poor alike. Inoculation and quarantine were the only means of protection. The former remained controversial throughout periods of its use, as it consisted of the deliberate production of what was hoped would be a mild case of the pox, and with recovery and immunity. Jenner's vaccination would not be available for another 20 years. Quarantine of inoculees was required, and hospitals were specifically

established to address soldiers affected by the virus. Inoculation occasionally resulted in community spread. The epidemic, or perhaps more correctly, the pandemic, spread throughout the continent (Fenn, 2002).

Smallpox was in army camps as in the poorer sections of crowded cities. It was a more serious problem for the colonials than for the British. The largest number of British troops came from London, where smallpox was endemic in the 17th and 18th centuries. (Tucker, 2001; Clark, 1995). Most young men of military age had already been exposed naturally to smallpox, and were thus immune to it. In the 1750's, the British army began routinely inoculating recruits who had not had smallpox or previously been inoculated for it. American military recruits and volunteers, on the other hand, tended to come more from the countryside. They were much less exposed to natural smallpox and even fewer had been inoculated. Fearing a penetration of British troops, the Americans sent a sizeable troop of about 2,000 soldiers to attack the British defending Quebec. The fortress was only lightly defended when the Americans arrived. The British governor gathered what troops he could for a makeshift defense. Shortly after their siege, smallpox broke out among the colonials. Because of cramped conditions, tired conditions of the troops, minimal nutrition and primitive sanitary conditions, the disease swept through the colonials. Over half the soldiers developed the disease, and mortality rates were extremely high. No one on the British side seemed to have been affected. Morale among the Americans quickly degenerated, and they withdrew to a military outpost where generals and privates alike continued to die at a high rate in one of the most serious outbreaks of the war (Clark, 1995).

For centuries it was known that if one survived an attack of smallpox, one could almost never catch it again (Wilson, 1994). They believed that a person who contracted smallpox through the skin in the same way that milkmaids caught cowpox through the cuts or calluses on

their hands had a good chance of survival. Cowpox was characterized by the appearance of irregular pustules on the cow's udders, however, the cow showed no signs of disease except for a slight decrease in milk production (Nicolau, 1997; Wilson, 1994). English physicians reported this phenomenon as early as 1765, but Edward Jenner actually put the milkmaid tales into practice. Jenner is credited in history as discovering the smallpox vaccine. He performed an experiment that laid the foundation for the eradication of smallpox and transformed human kind's fight against the disease (Banquet & Domingo, 1997). In 1796, he inoculated his first patient, an eight-year old boy with the cowpox virus; six weeks after the boy's reaction Jenner reinoculated him with smallpox virus, finding the result negative. The boy became immune to smallpox disease (Paustian, 2000; Wilson, 1994).

By 1798, Jenner had written an inquiry *about the Causes and Effects of the Variolae Vaccinae.* Although Jenner not only encountered public resistance and professional criticism when publicizing his findings, he also experienced difficulties in obtaining and preserving the cowpox vaccine. Nevertheless his procedure was soon accepted and the procedure quickly spread through Europe and to North America. As a result, mortality due to smallpox plunged (Microsoft Encarta Online Encyclopedia, 2003)

Jenner's experiments on the transmission of cowpox from human (not from cows to humans) were extraordinarily important because they meant that prophylaxis could be given even in the absence of the natural illness. He performed brilliant experimental work on the basis of popular beliefs in England. Jenner's work represented the first scientific attempt to control an infectious illness by the deliberate use of a vaccination. His work established the practice of vaccination, although the term would not become widely accepted until it was adopted by Pasteur 80 years later (Nicolau, 1997).

Remarkable success has occurred in achieving control of many communicable diseases, including the eradication of smallpox. It has been the only infectious illness ever to become extinct. There hasn't been a new case of smallpox anywhere since 1978 .The thirty-third Assembly of the World Health Organization certified that smallpox had been eradicated from the world on May 8, 1980 (Randal, 1996). It was only after years of effort by the WHO that several countries finally gave up their stocks of smallpox virus. The US Army Medical Research Institute of Infectious Disease, maintained a stock of smallpox virus until 1980 when it reported transferring variola virus strains to the Centers for Disease Control in Atlanta. South Africa also destroyed its variola stocks, leaving only two known laboratories in the world, which maintained the smallpox virus, the CDC and the Research Institute for Viral Preparations in Moscow (Capps, Vermund & Johnsen, 1986).

Although eradication was the ideal approach to reducing the economic and human health costs of the disease, there may have been both short and long-term consequences. A $300 million effort succeeded in completely eradicating smallpox in less than ten years. The campaign was effective because variola virus produced acute illness, had no carrier stage or non-human reservoirs, and had an effective vaccine that was used in combination with international surveillance and public education. It is now believed that smallpox eradication had limited economic consequences and left much of world's population highly susceptible to zoonotic orthopoxviruses (Nelson, 1999).

Much debate took place about the destruction of variola virus. Some felt that eliminating it would mean that future studies could not be conducted on it. Since the only non-scientific reason to have smallpox virus would be for offensive purposes, fears of biological warfare were

probably among the reason for the countries' reluctance to give it up (Capps, Vermund & Johnsen, 1986).

A fear that Iraq may possess the virus has lately become a forefront issue. Smallpox is lethal, can be produced in quantity, maintained in storage, transported and disseminated – thereby making it a great biological war weapon. An attack is unlikely to unleash a doomsday outbreak that could instantly get out of control. There is a window of up to 11 days between the time people contract the virus and the time they actually become sick and develop scabs (TB Outbreaks Week, 2001).

The vaccine is key to controlling smallpox and can be administered quickly and easily. Unless public health services have completely broken down, any outbreak could quickly be contained with the same surveillance-containment strategy used in past eradication campaigns (Capps, Vermund & Johnsen, 1986).

The United States now has sufficient vaccine to inoculate some 160 million people but only by diluting some existing doses. President Bush has announced one of the largest public health initiatives in decades, making the vaccine available, on a voluntary basis to healthcare workers. However, the vaccine carries risks but is one of the few vaccines that work relatively well even when given a couple of days after exposure (Unmesh, Land, Zarakhovich & Thompson, 2002).

Before the government ended the vaccination program in 1980, children were immunized as toddlers and usually again when they started school. If someone had three vaccinations, it would offer significant immunity for decades. However, others believe that the immunity induced by the smallpox vaccine faded after a decade. The level of immunity left in people

vaccinated before 1972 is uncertain and the CDC conservatively warns that the vaccine is most effective for three to five years (TB & Outbreaks Week, 2001 ; Wilson, 1994).

As part of bioterrorism preparedness activities, public health and hospital based health care providers are becoming familiar again with smallpox vaccine and techniques for administration. Since many health care workers today have never dealt with smallpox, the need for information and training about the disease has grown tremendously. Management today would involve many of the same approaches used 100 years ago: reporting local and national health authorities; isolation; treatment of symptoms and signs; and selective vaccination of patients and their contacts, medical staff and the community. However, today offers many advantages in managing a possible epidemic that did not exist a century ago. Therapeutic advances in supportive care and treatment of secondary bacterial infection offer benefits that were not available before. Other advances include a more developed state and national public health infrastructure, greater federal support and the experience of the World Health Organization's global Smallpox Eradication Program of the 1960s and 1970s (Albert, 2002; Gail 2002).

The threat of variola virus as a potential bioterrorism agent is lessoned by preparedness, including emergency guidelines from the Centers for Disease Control and Prevention; continued awareness and recognition of the disease by clinicians; the availability of large stocks of vaccine virus for use in the event of an outbreak; and ongoing research into antiviral drugs, novel vaccines and tests for early diagnosis Early, rapid diagnosis and containment are vitally important as the nation prepares for a possible smallpox disease outbreak. Immediate actions have been taken to ensure that the necessary precautions are in place (Albert, 2002; Marble, 2002).

The Center's for Disease Control and Prevention have updated a response plan previously developed in the 70's to respond to the potential threat of smallpox. The plan outlines public health strategies and approaches that would guide public health response to a smallpox emergency. The document also identifies federal, state and local public health activities that must be undertaken in a smallpox emergency (CDC Bioterrorism Update, Overview, Communications and Hospital Considerations, 2002).

North Carolina, in particular has made efforts to respond to a possible introduction of smallpox and other Category A agents into the human population. Efforts include upgrading existing surveillance equipment, establishing state and regional epidemiology surveillance teams and enhancing hospital preparedness. The North Carolina Office of Public Health Preparedness and Response is the lead authority of public health laws and has the power to impose quarantine and activate the state's pharmaceutical stockpile. Regional surveillance teams are located in the state and are trained to assist counties in the detection and investigation of diseases that may be due to bioterrorism. Teams also assist in response planning and implementation (Bioterrorism Update for Public Health and County Officials, 2002).

A part of the local health department's responsibility is to prepare their staff and to educate the citizens about smallpox and other bioterrorism issues. The education component is a part of the entire smallpox response plan. In collaboration with regional surveillance teams, health department staff has sponsored drills and exercises (i.e., smallpox tabletop, mock smallpox vaccination clinics, military base bioterrorism scenarios) to assess local agency readiness. Epi teams within local departments have been revisited and smallpox preparedness plans have been submitted to the Office of Public Health Preparedness and Response.

Pre-event vaccinations occur in two stages. During stage 1, a limited number of personnel (those likely to investigate or treat the earliest cases of smallpox) have occurred throughout the state. According to Dr. James Kirkpatrick, NC Bioterrrorism Coordinator, already more than 1,096 individuals have been vaccinated during this stage in North Carolina. In stage 2, a larger number of county personnel, including law enforcement, fire, emergency medical services, doctor's offices, etc. will be vaccinated local counties. Vaccinations during this stage would likely occur after additional vaccine was made available (Bioterrorism Update for Public Health and County Officials, 2002).

Pre-event vaccinations have occurred mostly in health departments with hospitals having the option to vaccinate their own staff. Vaccinations were performed by licensed nurses who received training and certification from the state immunization branch. Vaccine recipients were given information regarding the risks and benefits of the vaccine, contraindications and procedures to protect themselves as well as others. In the case of a smallpox occurrence in North Carolina, local health departments would be expected to vaccinate citizens via a mass vaccination clinic (Bioterrorism Update for Public Health and County Officials, 2002 ; Smallpox Decision Point for the Smallpox Vaccine Candidate, 2003) .

Efforts have been implemented to ensure that citizens are well educated. Local health departments have implemented various activities including community forums, newspaper articles, radio public service announcements, educational materials, etc. to inform citizens about smallpox. While educational efforts cannot alleviate the threat of smallpox introduction, good communication can impact how the public reacts to a possible health emergency. Lack of information can breed fear.

Health educators will play a key role in ensuring that local communities are educated about smallpox. A part of that responsibility is to develop a communication plan that will help local public health officials effectively educate the public, health care providers, policy makers and the media about smallpox issues prior to an outbreak or confirmed case of smallpox. The plan will instill and maintain public confidence in the public health system and its ability to respond to and manage a smallpox outbreak by providing accurate, rapid and complete information. Health educators as well as other pertinent public health personnel must be prepared to address public questions, false rumors and misinformation. The threat of a possible smallpox introduction is a serious issue. Accurate and timely information must be provided to the media and to citizens (CDC Interim Smallpox Response Plan Guidelines, 2001).

Educating the community about smallpox is not an easy task. Effective communication requires careful preparation of materials and messages. In the instance of a confirmed case of smallpox, tremendous media attention and coverage will occur. Managing media and citizen demands requires special coordination due to the sensitive nature of the issue. Health educators have attended various trainings to be able to respond appropriately.

The year 2001 proved that America was vulnerable to attacks of terrorism. It is thought that International countries and enemies of the U.S. may use smallpox as a weapon. Some experts fear that if an outbreak of smallpox were to occur, several factors could contribute to a more rapid spread of smallpox than was routinely seen before the disease was eradicated. Such factors include virtually non-existent immunity to smallpox in the absence of naturally occurring disease and discontinuation of routine vaccination in the United States in the early 70's, potentially delayed recognition of smallpox by health personnel who are unfamiliar with the disease and increased mobility and crowding of the population. Because of these factors, a single

case of smallpox would require an immediate and coordinated public health and medical response to contain the outbreak and prevent further a infection of susceptible individuals (CDC Interim Smallpox Response Plan, 2001).

The release of a chemical can cause injury or death when inhaled and injury through contact with skin or through ingestion of contaminated food. When used for hostile purposes, it is considered a weapon. The effects of such would be devastating for our country because not all agents cause death, some cause extended periods of illness and may cause a strain on the country's resources (Cole, 2003).

Many countries signed international agreements prohibiting such weapons. However following the Iran/Iraq war, it is believed that countries began to secretly develop and store biological weapons, thereby raising international awareness for the need to implement stronger efforts to control their use (Cole, 2003).

Total protection from an attack is difficult, however the U.S. is committed to ensuring the health and medical care of its citizens. Substantial progress has been made to enhance the nation's capability to respond to a bioterrorist event. However, there is more to be done to strengthen the response. The only way to know whether or not our country, state, county or city is really prepared to deal with a full scale public health emergency (such as a smallpox epidemic) is when or if one occurs.

## REFERENCES


Albert, M.A. (2002). Small Manifestation and Survival during the Boston Epidemic of 1901-1903. Retrieved February 1, 2003, from http://www.anals.org/volume.137.

Buckley, A. (1985). The god of smallpox: Aspects of Yoruba religious knowledge. Africa, 55, 188-199

Capps, L., Vermund, S., & Johnsen, C. (1986) Smallpox and biological warfare: The case for abandoning vaccination of military personnel, Journal of Public Health, 76, 1229-1231

CDC (2001). CDC interim response plan guidelines [Video].

CDC (2002). CDC bioterrorism, update, overview, communications and hospital considerations for public health and county officials [Video].

CDC ( 2003). Smallpox decision point for the smallpox vaccine candidate [Video].

Clark, W.R. (1995). At war within: The double-edged sword of immunity (1st ed.). Oxford University Press.

Cole, L.B. (2003). The eleventh plague: The politics of biological and chemical warfare. Retrieved April 7, 2003, from http://encarta.msn

Feierman, S. & Janzen, J.M. (1992). The social basis of health and healing in africa.

Fenn, E.A. (2002, May 22) Pox americana. The great smallpox epidemic of 1775-1982. Retrieved January 7, 2003, from http://jama.ama-assn.org/issues

Gail, Karen (2002). Smallpox What Every Clinician Should Know. National Immunization Program [Video].

Hopkins, D. R (1983). Princess and peasants: Smallpox in history. (1st ed) The University of Chicago Press.

Jenner, Edward," Microsoft® Encarta® Online Encyclopedia 2003 http://encarta.msn.com © 1997-2003 Microsoft Corporation.

Kher, U., Land, G., Zarakhovich, Y., & Thompson, M. (2002). The smallpox scenario. Retrieved on February 1, 2003, from http://web13.espnet.com

Kiernan, Vincent (1997). Deciding the fate of the smallpox virus. Technology Review,97,113-134.

Marble, M. (2002, January 15). Viral hemorrhagic fever, smallpox, anthrax discussed as bioterror weapons. Virus Weekly. Retrieved on February 1, 2003, from http:// www.virusweekly.com.

Nelson, A.M., (1999). The cost of disease eradication: Smallpox and bovine tuberculosis, Annals New York Academy of Science, 894:83-92

Nicolau, B.M.D. & Domingo, P. (1997). Small: The triumph over the most terrible of the ministers of Death. Annals of Internal Medicine, 127, 635-642.

Old Smallpox Vaccines May Still Help. (2001 December 4). TB & Outbreak Week.

Oldstone, M.B.A. (1998). Viruses, plagues and history. (1st ed.). The University of Chicago Press. Paustian,T. (2000). Small Pox, Yesterday and Today. Journal of Science and Education.

Randal, J (1996). A paradise for pathogens almost everywhere. USIA Electronic Journals,1, 1-4. Retrieved January 7, 2003 from the USIA electronic journal.

Smallpox Surveillance Worldwide. (1997, October 24). Morbidity & Morality Report, p. 990.

Tucker, J.B. (2001). Scourge The once and future threat of Smallpox (1st ed.). Grove Press. Library of Congress

Winslow, O.E. (1974). A destroying angel: The conquest of smallpox in

colonial boston. (1st ed). Oxford Press.

Wilson, S. (1994). On the matter of smallpox. Journal of Natural History, 103, 64 -69.

Albert, M. R., Ostheimer, K. G., Breman, J. G. (2001). The Last Smallpox Epidemic in Boston and the Vaccination Controversy, 1901-1903. *N Engl J Med* 344: 375-379